INTER- AND INTRASPECIFIC VARIATION IN THE RESOURCE USE OF BLOSSOMHEADED AND BLUEWINGED PARAKEETS IN SIRUVANI, TAMIL NADU, INDIA[1].

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(*With two text-figures*)

Key words: parakeet, *Psittacula cyanocephala, Psittacula columboides,* resource use, competition.

The blossomheaded (*Psittacula cyanocephala)* and bluewinged (*P. columboides)* parakeets were studied to identify the similarities or differences in their use of resources in the moist deciduous forest at Siruvani foothills, Coimbatore, Tamil Nadu, India. Data on foraging pattern and nest-site characteristics were collected for both the species. Comparisons were made between sexes using data on foraging and between species with data on nest-site characteristics. In both the species, intersexual difference was apparent in the selection of height, canopy and posture. Inter-specific difference was found in the selection of nest orientation and trees with different size class. Both the species in this area showed variation in the resource use to alleviate inter- and intraspecific competition.

Introduction

Studies on resource partitioning mostly demonstrate the ecological differences or similarities between species. Such differences or similarities are found or presumed to indicate the limits of interspecific competition on the number of species that can stably co-exist (Schoener, 1974) and are important in the generation of assembly rules for communities. But most of the attempts to characterise the foraging relations and associated niche characteristic of forest birds have not taken intersexual variation in foraging into account. This is largely due to the difficulties of clearly identifying the sex in the field. Moreover, obtaining sufficient sample sizes for each sex can also be a problem.

Studies of single species or small guilds, however, have shown that foraging patterns of males and females often differ, e.g., in species of woodpeckers (Kilham, 1965 and 1970; Ligon, 1986; Jackson, 1970; Williams, 1980), nuthatches (McEllin, 1979), Muscicapid flycatchers (Bell, 1982) and several warblers (Morse, 1968, 1971 and 1980). Understanding such differences or similarities at inter- and intraspecies level not only increases the understanding of a species niche in an area, but would also help to conserve the species.

A study was carried out on blossomheaded (*Psittacula cyanocephala)* and bluewinged *P. columboides)* parakeet in the moist deciduous forest at the foothills of Siruvani to evaluate how the sexes within a species differ in their use of resources (foraging pattern) and how both species differ in the nest-site selection. These species were selected since both are hole nesters and their ecology is poorly known.

Study area

The Siruvani foothills come within the core area of Nilgiri Biosphere Reserve and lie from 10° 56' to 10° 58' N and 76° 42' to 76° 44' E, at 350 to 650 m above msl. Temperature ranges from 24° C to 38° C during the day time and

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from 18° C to 29° C at night. The average relative humidity is 51%. The area received both southwest and northeast monsoon. The mean annual rainfall is about 842 mm. The river Noyil drains this area. The vegetation type has been classified as "Southern Tropical Moist Deciduous" (Champion and Seth, 1968) and it merges with the Southern Tropical Evergreen Forests at higher elevations in Muthikolam area of Kerala state. The common tree species in the study area are *Lagerstroemia lanceolata*, *Terminalia bellerica*, *T. paniculata*, *Antidesma diandrum*, *Piliostigma malabaricus* and *Bauhinia racemosa*.

Methods

The parakeet species and their sex were determined by the colour of the plumage and calls (Ali and Ripley 1987).

Foraging records. Foraging behaviour was quantified following Holmes *et al.* (1978). Birds were followed and the first attempt to capture food was recorded. Only one foraging record (Initial) was taken from any individual, but it was not possible to prevent or quantify observations of the same individual on different days. For each foraging attempt, the foraging height, method, substrate, plant species from which the food was taken and the type of food were recorded. Foraging attempts were divided into seven height classes (0-2 m, 2-4 m, 4-6 m, 6-8 m, 8-10 m, 10-12 m and >12 m), based on the general physiognomy of the vegetation. All foraging attempts were assigned to ten substrate categories under three major classes: 1. Plant form (tree, shrub), 2. Branches (primary, secondary, tertiary, twigs), 3. Canopy (top, side, middle and lower).

The position or posture of the bird on the branch while feeding was classified based on Remsen and Robinson (1990).

A= "hang-up" on vertical perch, B= "hang-sideways" on vertical perch, C = "hang-down" on vertical perch, D = "hang-up" on horizontal perch, E = "hang-down" on horizontal perch, and F = "hang-upside down" on horizontal perch. All these categories were based on how a bird positions itself on a branch to acquire its food (Fig. 1).

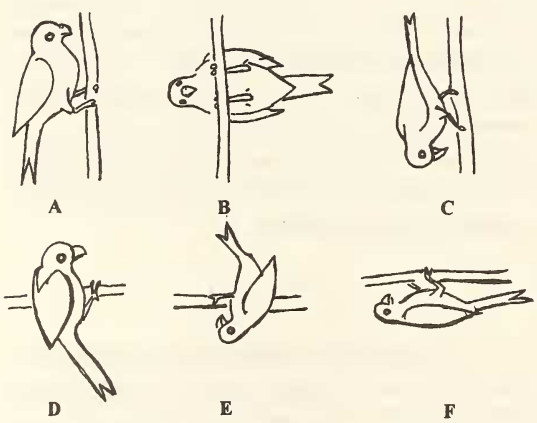

Fig. 1: Posture adopted while feeding by both parakeets

Data were mostly collected within the first four hours after sunrise. Each foraging attempt was considered as an observation for all analyses.

Phenological records. The phenology of dominant food plant species was recorded to assess food availability during the study period. Ten individuals of each plant species were marked and monitored every 15 days. All the vegetative and reproductive phases were assigned in percentage according to their availability.

Nest-site selection. Intensive nest search was made throughout the area. A hole was confirmed to be occupied if adults were seen to perform activities related to breeding near the nest. Data were collected on nest height (height of the nest from ground level), tree species used for nesting, Girth at breast height (Gbh) of nesting tree, Girth at nest level, nest hole diameter, nest hole depth and orientation of the nest hole on the tree.

Statistical analyses. The χ^2 test of independence was used to identify the variation in the resource use between species and sexes.

Mann-Whitney *U* test was performed for nest-site variables.

Results

Four types of food items i.e. fruit, seed, flower and sprouting leaves, were recorded for both the parakeets. Flowers and nectar were the predominant food for both the sexes and species. No parakeets showed any variation in the type of food used (Table 1).

Table 1
FOOD ITEMS OF BLOSSOMHEADED AND BLUEWINGED PARAKEETS (%)

Species	Sex	Fruits	Seeds	Flowers	Leaves
Blossomheaded Parakeet	Male	8	6	65	21
	Female	8	9	65	18
Bluewinged Parakeet	Male	8	10	49	33
	Female	3	18	61	18

Blossomheaded Parakeet: In all, 352 feeding observations of blossomheaded parakeet were made, of which the male and female observations were 189 and 163 respectively.

Both the sexes preferred trees to shrubs. Within the tree, both the sexes preferred only the top and side canopy. The difference in canopy preference between the sexes was not significant. No bird was ever observed feeding in the lower canopy. In general, twigs were preferred to the same extent by both sexes (Table 2).

Of the six positions or postures (A, B, C, D, E and F), the male and female used mostly "D" and "E" type respectively. Interestingly, "A" was the next type preferred by both the sexes (Table 3). Position "F" was the least preferred by both the sexes. Overall, the posture used differed significantly between sexes ($\chi^2 = 41.1$, $P<0.05$). Interestingly, it differed significantly between the months in both male ($\chi^2 = 30.09$ $P<0.05$) and female ($\chi^2 = 42.9$ $P<0.05$). In height use, though sexes did not differ significantly over different months, overall they showed a significant difference ($\chi^2 = 20.40$, $P<0.05$). In general, male and female highly preferred 6-10 m height class. The female showed a higher preference for 8-10 m height class (61%) over the male (44%) while the male showed higher preference for the >10 m height class (30%) than the female (21.5%).

Bluewinged parakeet: Altogether 492 foraging observations were made for bluewinged parakeet, of which 287 observations were on male and 205 on female. Both males and females of bluewinged parakeet preferred only trees. No foraging was observed on shrubs. Both the sexes selected only top and side canopy of the trees. The top canopy was highly preferred, while the middle and lower canopies were least preferred by both the sexes. Sexes showed a similarity in canopy preference.

Table 2
PERCENT FREQUENCY OF SUBSTRATE USED BY BLOSSOMHEADED PARAKEET

Sex	Month	Tree	Shrub	Canopy			Branches			
				Top	Side	Middle	Primary	Secondary	Tertiary	Twigs
Male	Dec	94	6	78	16	6	12	30	7	51
	Jan	90	10	34	66	0	0	0	49	51
	Feb	96	4	39	61	0	0	0	27	73
	Overall	94	6	53	44	3	5	12	23	60
Female	Dec	96	4	78	15	7	14	28	15	43
	Jan	92	8	55	45	0	0	0	58	42
	Feb	96	4	18	82	0	0	0	18	82
	Overall	95	5	47	50	3	10	10	20	60

TABLE 3
PERCENT FREQUENCY OF HEIGHT AND POSTURE USED BY BLOSSOMHEADED PARAKEET

Sex	Month	Posture used						Height class (m)						
		A	B	C	D	E	F	0-2	2-4	4-6	6-8	8-10	10-12	>12
Male	Dec	72	0	0	11	17	0	0	0	0	14	27	8	51
	Jan	26	5	13	31	20	5	10	0	2.6	36	46	5.4	0
	Feb	19	18	0	57	6	0	4	0	0	22	58	16	0
	Overall	28	12	4	43	11	2	3.5	0	0.5	22	44	11	19
Female	Dec	46	15	15	9	15	0	0	7	3.5	7	26	3.5	53
	Jan	47	6	14	19	8	6	8	0	0	25	61	6	0
	Feb	7	29	0	7	57	0	0	4	0	6	90	0	0
	Overall	24	20	6	10	38	2	2	4.3	1.2	10	61	3.5	18

A = "hang-up" on vertical perch; B = "hang-sideways" on vertical perch; C = "hang-down" on vertical perch; D = "hang-up" on horizontal perch; E = "hang-down" on horizontal perch, and F = "hang-upside down" on horizontal perch.

Both the sexes preferred twigs and no significant difference was observed in this respect (Table 4).

The position (A, B, C, D, E and F) used showed significant difference between sexes (χ^2 = 20.38, P= 0.001) overall, and it differed even monthwise for both male (χ^2 = 17.83, P<0.05) and female (χ^2 =25.96, P<0.05). Of the six types of positions, the male did not perform type "F" but the female opted for all the types. Interestingly, type "B" was the second preference of both the sexes (Table 5). Regardless of sex, the bluewinged parakeet mostly preferred > 8 m height class throughout the period (Table 5). They were not observed feeding on 0-2 m category. Regardless of months, sexes significantly differed in height selection (χ^2 = 22.5, P<0.05). Male showed a higher preference (43%) for >10 m height class than the female (29%).

Nest-site characteristics. In all 12 nests of blossomheaded and 11 nests of bluewinged parakeet were located. Tree species namely *Grewia tillifolia*, *Tectona grandis*, *Albizia odoratissima*, *Lagerstroemia lanceolata and Melia dubia* were used for nesting by both the species. The majority of bluewinged parakeet nests were found in *Grewia tillifolia* (64%)

TABLE 4
PERCENT FREQUENCY OF SUBSTRATE USED BY BLUEWINGED PARAKEET

Sex	Month	Canopy			Branches			
		Top	Side	Middle	Primary	Secondary	Tertiary	Twigs
Male	Dec	79	15	6	13	27	12	48
	Jan	79	21	0	0	0	16	84
	Feb	89	11	0	0	5	24	71
	Overall	81	15	4	4	7	19	70
Female	Dec	80	13	7	12	25	16	47
	Jan	78	22	0	0	0	26	74
	Feb	49	51	0	0	0	9	91
	Overall	72	26	2	8	19	15	58

TABLE 5
PERCENT FREQUENCY OF HEIGHT AND POSTURE USED BY BLUEWINGED PARAKEET

Sex	Month	Posture used						Height class (m)					
		A	B	C	D	E	F	2-4	4-6	6-8	8-10	10-12	>12
Male	Dec	57	9	9	9	16	0	4	2	10	27	5	52
	Jan	45	39	11	5	0	0	0	11	26	39	24	0
	Feb	71	16	0	10	3	0	0	0	23	60	17	0
	Overall	60	20	6	8	6	0	3	3	15	36	10	33
Female	Dec	46	15	15	9	15	0	7	4	7	27	4	51
	Jan	48	33	13	4	1	1	0	11	26	44	19	0
	Feb	18	51	20	0	11	0	0	0	31	51	18	0
	Overall	40	36	15	3	5	1	2	6	22	41	15	14

A = "hang-up" on vertical perch; B = "hang-sideways" on vertical perch; C = "hang-down" on vertical perch; D = "hang-up on horizontal perch; E = "hang-down" on horizontal perch, and F = "hang-upside down" on horizontal perch.

followed by *Melia dubia* (27%). Similarly, blossomheaded parakeet nests were mostly on *Grewia tillifolia* (42%) and *Tectona grandis* (42%).

The bluewinged parakeet preferred to select holes at higher places (7.88 ± 3.23 m) than blossomheaded parakeet (6,44 ± 3.23 m). Moreover, bluewinged parakeets select taller and bigger trees for nesting than the blossomheaded (Table 6). Both the species showed difference in the nest orientation (Fig 2). Among the four

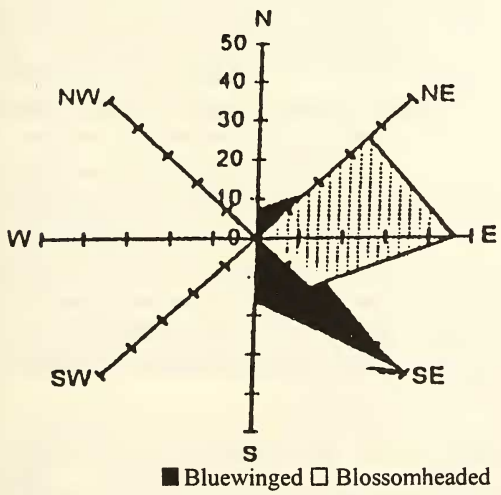

Fig.2: Orientation of nest holes of parakeets

TABLE 6
NEST-SITE CHARACTERISTICS OF BLOSSOMHEADED PARAKEET AND BLUEWINGED PARAKEET

Variables	Blossomheaded Parakeet (n=12)		Bluewinged Parakeet (n=11)	
Plant species	Frequency	%	Frequency	%
Grewia tillifolia	5	42	7	64
Tectona grandis	5	42	1	9
Albizia odoratissima	1	8	0	0
Lagerstroemia lanceolata	1	8	0	0
Melia dubia	0	0	3	27
	12		11	
	Mean	SD	Mean	SD
Nest height (m)	6.44	±3.23	7.88	±3.23
Nest tree height (m)	13.46	±2.34	14.49	±1.31
Nest tree DBH (m)	1.5	±0.52	1.81	±0.32
Diameter at nest level (m)	1.06	±0.48	1.10	±0.30

variables (nest height, nest tree height, tree girth at breast height (gbh) and girth at nest hole level), significant difference was observed between the two species only in tree gbh (U = -2.4, P=0.01).

Discussion

The bluewinged and the blossomheaded parakeet showed a preference for sprouting leaves and flowers (nectar). Ali and Ripley (1987) have reported that grains and fruits are the preferred food of blossomheaded and bluewinged parakeet, and they also eat buds, petals and nectar. Balasubramanian (1986) reported that the roseringed parakeet feeds on leaves in the absence of fruits. During this study, fruit availability was low. The observed preference for flowers and sprouting leaves is, therefore, a strategy to exploit an alternative food resource.

Intersexual differences. Of the six dimensions (food, plant form, height, canopy, branches and posture) used, there was significant difference in height and posture between sexes. In the case of foraging posture, significant difference was shown by both the species. The difference was notable even between different months. Parakeets normally forage in flocks and feed very close to each other on the same plant. If any one of them is disturbed or starts flying, all flee immediately. The availability of perches (twigs or branches) near the resources are insufficient to accommodate all the flock members, and hence, each individual chooses different foraging postures. Normally, horizontal perches and sitting upright seem to be more comfortable than the vertical or other postures. As the available space is occupied by the first arrival or on hierarchical basis, other individuals are forced to use the next available perch. This could be to avoid predation, or as a result of their social behaviour.

In height use, the male preferred greater height classes than the female. For both the sexes, the resources were the same, but the way in which they were exploited was different. For example, both the sexes preferred flowers and sprouting leaves available mostly on the top and side canopies, but utilised the resources at different height classes and by different methods. The differences in sexes can be attributed as a means to alleviate intraspecific competition (Rand, 1952 and Selander, 1966). Another reason could be that they forage near their centres of activity, which differ between sexes in the breeding season for passerine birds. During the breeding season, males are more conspicuous and effective in long distance communication with females when they are at greater heights and feed near their song perches; likewise, females forage in lower strata near nests (Morse, 1968 and 1980). Though the result supports both the hypotheses, the "centres of activity" hypothesis is meant perhaps only for breeding individuals and passerines. But in the present study, data was collected on both breeding and non-breeding individuals of non-passerines. It may be noted that inclusion of both breeders and non breeders would probably distort the result. Thus our results would be meaningful if the reason for differences in the resource use between sexes is intraspecific competition, rather than the centres of activity.

Inter-specific differences. Cavity nesters pose a unique habitat problem. Obligate cavity-nesting is generally associated with intra- and interspecific competition for nest sites (Collias and Collias, 1984 and Nilsson, 1984) and such competition was found to result in bird species selecting nest holes that differed in height, size, shape and orientation (Edington and Edington 1972, Van Balen *et al.* 1982). In their nest-site requirements, both species of parakeets differed in the selection of plant species in terms of their size. The bluewinged showed some consistency in selecting a particular plant species, as well as size of the tree. The selection of *Grewia tillifolia* by the majority for nesting can be attributed to its greater height and spread. The bluewinged parakeet starts nesting earlier than the blossomheaded, therefore the probability of its selecting the most suitable holes for nesting was greater than the latter.

In conclusion, it may be stated that differences in the selection of nest height, orientation, mature tree and time of breeding between these two congeneric parakeets may

enable them to coexist in this moist deciduous habitat.

ACKNOWLEDGEMENTS

We wish to thank Dr. P. A. Azeez, Principal Scientist, SACON, and Dr. Justus Joshua, Research Associate, Wildlife Institute of India for reading the manuscript and suggesting valuable improvements; special thanks to Dr. V. S. Vijayan, Director, SACON, for computer and library facilities in SACON. We are greatly indebted to the Tamil Nadu Forest Department for their help and co-operation during the study.

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